Remarks

Initially, applicant affirms the election of Group II, claims 8-10, as set forth in the restriction requirement. Claims 8-10 remain in the application, while claims 1-7 have been withdrawn from consideration by the Examiner as being drawn to a non-elected invention.

Applicants have amended claim 9 to more clearly define the present invention. In particular, claim 9 has been amended to change the previous phrase "homogeneous precursor mixture" to the more precise "mixture of co-reactant precursors". In addition, the phrase "while retaining said nanostructure" has been added to clearly denote that the nanostructure is maintained in the final desirable effect of the process in compound.

The Examiner has rejected claims 8-10 under 35 USC 102(b) as being anticipated by Peramunage et al. In particular, the Examiner finds that Peramunage et al teaches a particulate strain lithium titanate intercalation compound (pg 2609) having "submicron dimensions" and "even finer particles and smaller agglomerates (pg 2610).

With respect to claim 9, the Examiner has disregarded the method limitations as not further limiting the product claim.

For claim 10, the Examiner indicates that Peramunage et al "specifically teaches an anode comprising the $Li_4Ti_5O_{12}$ material (p. 2610)", and also notes that a separator of a polymer electrolyte membrane is utilized.

These rejections are respectfully traversed and it is respectfully submitted that the present invention as defined by present claims 8-10 are patentably distinct from Peramunage et al.

As noted in the Background section of the present specification Peramunage et al builds upon the earlier cited work of Ohzuku et al in the recognition that $Li_4Ti_5O_{12}$ compounds can function as zero strain intercalation compounds. However, that is where the similarity between Peramunage et al and the present invention ends. In particular, the lithium titanate intercalation compounds, typically $Li_4Ti_5O_{12}$, of Peramunage et al are specifically described as "micron-sized" (note the Title, Abstract, Introduction, etc. of Peramunage et al) which is at least an order of magnitude larger than the nanostructure particulate compound required by the present claims.

In this light, the Examiner's rejection is based upon the erroneous characterization of the Peramunage et al publication as disclosing a "nanostructure particulate zero strain lithium titanate intercalation compound" (emphasis added). Contrary to the Examiner's allegation, Peramunage et al does not, teach or suggest nanostructure compound nor "specifically teach[es] that the $Li_4Ti_5O_{12}$ has 'submicron dimensions'". Rather, Peramunage et al discloses "preparation of micron-sized $Li_4Ti_5O_{12}$ ..." (see Title, Abstract, Introduction, etc.) and that "Specifically, micro-sized $Li_4Ti_5O_{12}$ was obtained by heating a mixture of TiO_2 and Li_2CO_3 powders composed of submicron particles" (see Introduction). Thus, the Examiner's indication that the lithium titanate product of Peramunage et al is of submicron dimension is clearly in error. Rather, as noted throughout Peramunage et al, the lithium titanate

compound is of micron size. It should be noted that even if the lithium titanate product of Peramunage et al was of the "submicron" dimension that such in itself fails to disclose a nanostructure dimension of the present invention, as "submicron" particle sizes can be nearly an order of magnitude larger than those of nanostructure.

The Examiner has erroneously attributed the discussion of "submicron dimensions" in Peramunage et al (column 2 of pg 2610) to the $Li_4Ti_5O_{12}$ product rather than properly to the precursor materials; i.e. TiO_2 and Li_2CO_3. (Also note column 2 of pg 2612 which clearly describes "submicron-size TiO_2).

The Examiner's further misinterpretation of the Peramunage et al discussions is apparent in the assertion that the phrase "even finer particles" relates to yet smaller than submicron $Li_4Ti_5O_{12}$ product when actually the phrase was clearly used by Peramunage et al to compare the product obtained using Li_2CO_3 with that using LiOH (Note Fig 3 and discussion thereof). The $Li_4Ti_5O_{12}$ products themselves, are both expressly stated by Peramunage et al as being in the micron-size range.

In the rejection of claim 9, the Examiner's dismissal of the process limitations as not being "given patentable weight" is improper, since product-by-process claims have long been recognized as a "permissible technique that applicant may use to define the invention". (MPEP 806.05(f)) Where, as here, the process limitations define the resulting novel, unanticipated product, viz., a nanostructure particulate zero strain lithium titanate intercalation compound, those limitations do, indeed, carry patentable weight. In this light claim 9 has been amended to include the nanostructure limitation in the of that

resulting product, the confirming "nanostructure" term to the preamble description of the claimed product.

The rejection of claim 10 essentially repeats the assertions noted with respect to claim 8 which have been shown to be erroneous above.

It has been long established that rejections based on anticipation or lack of novelty requires that all of the elements of the claimed invention be described in a single reference, and that anticipation occurs only when some single prior article, patent, or publication contains within its four corners every element of the claim in question. (See In re Spada, 15 USPQ 2nd 1655, (CAFC 1990) and Paeco, Inc v. Applied Molding, Inc., 194 USPQ 353, (CA3 1977), among numerous others).

It is clear from the above discussion that Peramunage et al fails the "four corner" test required for anticipation of the nanostructure compound according to the present invention. Further, Peramunage et al fails to teach, suggest or imply the present invention. Therefore, it is respectfully submitted that the rejection of claims 8-10 under 35 USC 102(b) must be withdrawn.

The Examiner has also rejected claim 9 under 35 USC 102(b) as being anticipated by Exnar et al. The Examiner suggests that Exnar et al teaches a particulate lithium titanate intercalation compound (col. 2, lines 45-48) and again disregards the method limitations.

This rejection is respectfully traversed and it is respectfully submitted that the present invention as defined by claim 9 is patentably distinct from Exnar et al.

Contrary to the Examiner's assertions, Exnar et al does not teach or suggest a lithium titanate nor a zero strain intercalation compound as required by present claim 9. Rather, as is clear from the specific cite made by the Examiner (col.2 lines 45-48), that Exnar et al forms only a nanocrystalline TiO_2 compound. In particular, Exnar et al specifically states that "[i]n the presence of lithium ions, the titanium dioxide in nanocrystalline form is liable to form an intercalated compound Li_xTiO_2" (emphasis added). The difference between this and the present invention is clear. The fact that the TiO_2 of Exnar et al may be intercalated with lithium ions, does not result in a lithium titanate compound nor mean that the result is an intercalation compound.

Further, it is clear that Exnar et al refers only to TiO_2 as a nanoparticulate compound useful in battery cell electrodes, but does not describe a nanostructure particulate lithium titanate intercalation compound as required by present claim 9.

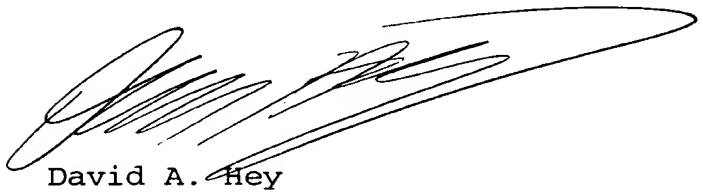
Once again the Examiner has failed to provide a reference which meets the "four corners" test for anticipation. Therefore, it is respectfully submitted that the rejection of claim 9 under 35 USC 102(b) as being anticipated by Exnar et al, must be withdrawn.

In view of the above amendments and remarks, early consideration and allowance of all pending claims, i.e. claims 8-10, are respectfully requested.

For the convenience of the Examiner and the USPTO, an appendix setting forth the status of all claims related to this

application is attached. No amendment markings are shown in the appendix.

Respectfully submitted,



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Version With Markings To Show Changes Made

9. A nanostructure particulate lithium titanate intercalation compound synthesized by a method comprising:

providing a homogeneous [precursor] mixture of co-reactant precursors comprising nanostructure TiO_2 and at least one thermolabile source of lithium ions;

heating said [precursor] mixture rapidly to a reactive annealing temperature of about 750-800°C;

holding said mixture at said annealing temperature for a period of time not substantially longer than that required to effect the maximum available reaction of said mixed precursors [precursor components] in synthesizing said nanostructure intercalation compound particles; and

cooling said synthesized particles rapidly to a temperature below the reaction temperature required for the synthesis of said intercalation compound, thereby preventing further growth of said particles while retaining said nanostructure.

Appendix

Status of Claims

1. Withdrawn from consideration.
2. Withdrawn from consideration.
3. Withdrawn from consideration.
4. Withdrawn from consideration.
5. Withdrawn from consideration.
6. Withdrawn from consideration.
7. Withdrawn from consideration.

8. A nanostructure particulate zero strain lithium titanate intercalation compound.

9. A nanostructure particulate lithium titanate intercalation compound synthesized by a method comprising:

providing a homogeneous mixture of co-reactant precursors comprising nanostructure TiO_2 and at least one thermolabile source of lithium ions;

heating said mixture rapidly to a reactive annealing temperature of about 750-800°C;

holding said mixture at said annealing temperature for a period of time not substantially longer than that required to effect the maximum available reaction of said mixed precursors in synthesizing said nanostructure intercalation compound particles; and

cooling said synthesized particles rapidly to a temperature below the reaction temperature required for the synthesis of said intercalation compound, thereby preventing further growth of said particles while retaining said nanostructure.

10. A rechargeable electrochemical cell comprising:

a negative electrode member comprising a first electrochemically active material;

a positive electrode member comprising a second electrochemically active material; and

a separator member comprising an electrolyte interposed between said negative and positive electrode members;

wherein at least one of said active materials comprises a nanostructure particulate zero strain lithium titanate intercalation compound.